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A BOBBIN CAPABLE OF RELIABLY INSULATING
A FIRST COIL FROM A SECOND COIL

Background of the Invention:

This invention relates to a bobbin and to a transformer which comprises a bobbin under consideration. A conventional bobbin comprises a sleeve, a plurality of divider plates, and first and second end plates. The sleeve has a sleeve internal surface which defines a sleeve perforation. The divider plates are attached to the sleeve with a space left between two adjacent ones of the divider plates and with the divider plates perpendicular to the sleeve. The first and the second end plates are attached to side ends of the sleeve with a space left between one of the divider plates and each of the first and the second end plates.

A conventional transformer comprises the bobbin, first and second coils attached to the bobbin, a magnetic core attached to the bobbin, and first-set and second-set connectors. The first and the second coils are attached around the sleeve between the divider plates. The first and the second coils are connected to the first-set and the second-set converters, respectively.

In the bobbin and the transformer, it is hardly possible to reliably insulate the first coil from the



second coil by the divider plates. This is because the divider plates do not surround the first coil or the second coil. Also, inasmuch as the divider plates are perpendicular to the sleeve and are high in height, the
5 bobbin and the transformer are high in height.

Summary of the Invention:

It is therefore an object of this invention to provide a bobbin or a transformer which is capable of reliably insulating a first coil from a second coil.

10 It is another object of this invention to provide a bobbin or a transformer which is low in height.

Other objects of this invention will become clear as the description proceeds.

According to a first aspect of this invention,
15 there is provided a bobbin which comprises (A) a first board having a first board main surface and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface and second and
20 third board internal surfaces which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation
25 associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second



sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the second board with the divider sleeve surrounding the second sleeve and the third board perforation and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the first sleeve, the divider sleeve being welded to the first board main surface.

According to a second aspect of this invention, there is provided a bobbin which comprises (A) a first board having a first board main surface and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface and second and third board internal surfaces which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second board



perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the second board with the divider sleeve surrounding the second sleeve and the third board perforation and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the first sleeve, the divider sleeve being glued to the first board main surface.

According to a third aspect of this invention, there is provided a bobbin which comprises (A) a first board having a first board main surface and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface and second and third board internal surfaces which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve



perforations receiving the first sleeve; and (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the first board with the
5 divider sleeve surrounding the first sleeve and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the second sleeve and the third board perforation, the divider sleeve being welded to the
10 second board main surface.

According to a fourth aspect of this invention, there is provided a bobbin which comprises (A) a first board having a first board main surface and a first board internal surface which defines a first board perforation;
15 (B) a second board having a second board main surface opposed to the first board main surface and second and third board internal surfaces which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first
20 sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve
25 being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a



divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the first board with the divider sleeve surrounding the first sleeve and with the
5 divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the second sleeve and the third board perforation, the divider sleeve being glued to the second board main surface.

10 According to a fifth aspect of this invention, there is provided a bobbin which comprises (A) a first board having a first board main surface and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface
15 opposed to the first board main surface, a second board subsidiary surface, and second, third, fourth, and fifth board internal surfaces which define second, third, fourth, and fifth board perforations; (C) a first sleeve having a first sleeve internal surface which defines a
20 first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve
25 being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; (E) a divider

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sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the second board with the divider sleeve surrounding the second sleeve and the third board perforation and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the first sleeve and is brought into contact with the first board main surface; and (F) first and second coupling arms having first and second coupling peak portions, the first and the second coupling arms being integral with the first board, the first and the second coupling arms passing through the fourth and the fifth board perforations with the first and the second coupling peak portions brought into contact with the second board subsidiary surface.

According to a sixth aspect of this invention, there is provided a bobbin which comprises (A) a first board having a first board main surface and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary surface, and second, third, fourth, and fifth board internal surfaces which define second, third, fourth, and fifth board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second

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sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second board

5 perforation, the second board and the second sleeve perforations receiving the first sleeve; (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the first board with the divider

10 sleeve surrounding the first sleeve and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the second sleeve and the third board perforation and is brought into contact with the second board main surface;

15 and (F) first and second coupling arms having first and second coupling peak portions, the first and the second coupling arms being integral with the first board, the first and the second coupling arms passing through the fourth and the fifth board perforations with the first

20 and the second coupling peak portions brought into contact with the second board subsidiary surface.

According to a seventh aspect of this invention, there is provided a bobbin which comprises (A) a first board having a first board main surface and a first board

25 internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary surface, second and third board internal



surfaces which define second and third board perforations, and first and second ditch surfaces which reach from the second board main surface to the second board subsidiary surface and define first and second
5 ditches; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve
10 having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations
15 receiving the first sleeve; (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the second board with the divider sleeve surrounding the second sleeve and the third board perforation and
20 with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the first sleeve and is brought into contact with the first board main surface; and (F) first and second coupling arms having first and second coupling
25 peak portions, the first and the second coupling arms being integral with the first board, the first and the second coupling arms passing through the first and the second ditches with the first and the second coupling



peak portions brought into contact with the second board subsidiary surface.

According to an eighth aspect of this invention, there is provided a bobbin which comprises (A) a first
5 board having a first board main surface and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary surface, and second and third board internal
10 surfaces which define second and third board perforations, and first and second ditch surfaces which reach from the second board main surface to the second board subsidiary surface and define first and second ditches; (C) a first sleeve having a first sleeve
15 internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a
20 second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a divider sleeve
25 having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the first board with the divider sleeve surrounding the first sleeve and with the divider sleeve



interposed between the first and the second board main surfaces so that the divider sleeve surrounds the second sleeve and the third board perforation and is brought into contact with the second board main surface; and (F) first and second coupling arms having first and second coupling peak portions, the first and the second coupling arms being integral with the first board, the first and the second coupling arms passing through the first and the second ditches with the first and the second coupling peak portions brought into contact with the second board subsidiary surface.

According to a ninth aspect of this invention, there is provided a transformer which comprises a bobbin, first and second coils attached to the bobbin, first and second magnetic cores attached to the bobbin, and first-set and second-set connectors fixed to the bobbin, wherein: the bobbin comprises (A) a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary surface, and second and third board internal surfaces which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second



sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second board

5 perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the second board with the

10 divider sleeve surrounding the second sleeve and the third board perforation and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the first sleeve, the divider sleeve being welded to the first

15 board main surface; the first coil being attached around the divider sleeve and being connected to the first-set connectors, the second coil being attached around the second sleeve and being connected to the second-set connectors through the third board perforation; the first

20 magnetic core having a first leg, the first magnetic core being brought into contact with the first board subsidiary surface with the first leg inserted in the first sleeve perforation, the second magnetic core having a second leg, the second magnetic core being brought into

25 contact with the second board subsidiary surface with the second leg inserted in the first sleeve perforation and brought into contact with the first leg.



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According to a tenth aspect of this invention, there is provided a transformer which comprises a bobbin, first and second coils attached to the bobbin, first and second magnetic cores attached to the bobbin, and

5 first-set and second-set connectors fixed to the bobbin, wherein the bobbin comprises (A) a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a

10 second board main surface opposed to the first board main surface, a second board subsidiary surface, and second and third board internal surfaces which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first

15 sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve

20 being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a divider sleeve having a divider sleeve internal surface

25 which defines a divider sleeve perforation, the divider sleeve being integral with the second board with the divider sleeve surrounding the second sleeve and the third board perforation and with the divider sleeve

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interposed between the first and the second board main surfaces so that the divider sleeve surrounds the first sleeve, the divider sleeve being glued to the first board main surface; the first coil being attached around the divider sleeve and being connected to the first-set connectors, the second coil being attached around the second sleeve and being connected to the second-set connectors through the third board perforation; the first magnetic core having a first leg, the first magnetic core being brought into contact with the first board subsidiary surface with the first leg inserted in the first sleeve perforation, the second magnetic core having a second leg, the second magnetic core being brought into contact with the second board subsidiary surface with the second leg inserted in the first sleeve perforation and brought into contact with the first leg.

According to an eleventh aspect of this invention, there is provided a transformer which comprises a bobbin, first and second coils attached to the bobbin, first and second magnetic cores attached to the bobbin, and first-set and second-set connectors fixed to the bobbin, wherein the bobbin comprises (A) a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary surface, and second and third board internal surfaces



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which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; 5 (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second 10 board perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the first board with the 15 divider sleeve surrounding the first sleeve and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the second sleeve and the third board perforation, the divider sleeve being welded to the 20 second board main surface; the first coil being attached around the divider sleeve and being connected to the first-set connectors, the second coil being attached around the second sleeve and being connected to the second-set connectors through the third board 25 perforation; the first magnetic core having a first leg, the first magnetic core being brought into contact with the first board subsidiary surface with the first leg inserted in the first sleeve perforation, the second



magnetic core having a second leg, the second magnetic core being brought into contact with the second board subsidiary surface with the second leg inserted in the first sleeve perforation and brought into contact with
5 the first leg.

According to a twelfth aspect of this invention, there is provided a transformer which comprises a bobbin, first and second coils attached to the bobbin, first and second magnetic cores attached to the bobbin, and
10 first-set and second-set connectors fixed to the bobbin, wherein the bobbin comprises (A) a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a
15 second board main surface opposed to the first board main surface, a second board subsidiary surface, and second and third board internal surfaces which define second and third board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first
20 sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve
25 being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; and (E) a



divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the first board with the divider sleeve surrounding the first sleeve and with the
5 divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the second sleeve and the third board perforation, the divider sleeve being glued to the second board main surface; the first coil being attached around
10 the divider sleeve and being connected to the first-set connectors, the second coil being attached around the second sleeve and being connected to the second-set connectors through the third board perforation; the first magnetic core having a first leg, the first magnetic core
15 being brought into contact with the first board subsidiary surface with the first leg inserted in the first sleeve perforation, the second magnetic core having a second leg, the second magnetic core being brought into contact with the second board subsidiary surface with the
20 second leg inserted in the first sleeve perforation and brought into contact with the first leg.

According to a thirteenth aspect of this invention, there is provided a transformer which comprises a bobbin, first and second coils attached to
25 the bobbin, first and second magnetic cores attached to the bobbin, and first-set and second-set connectors fixed to the bobbin, wherein the bobbin comprises (A) a first board having a first board main surface, a first board



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subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary
5 surface, and second, third, fourth, and fifth board internal surfaces which define second, third, fourth, and fifth board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with
10 the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second
15 sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve
20 being integral with the second board with the divider sleeve surrounding the second sleeve and the third board perforation and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the first sleeve and is
25 brought into contact with the first board main surface; and (F) first and second coupling arms having first and second coupling peak portions, the first and the second coupling arms being integral with the first board, the



first and the second coupling arms passing through the fourth and the fifth board perforations with the first and the second coupling peak portions brought into contact with the second board subsidiary surface; the
5 first coil being attached around the divider sleeve and being connected to the first-set connectors, the second coil being attached around the second sleeve and being connected to the second-set connectors through the third board perforation; the first magnetic core having a first
10 leg, the first magnetic core being brought into contact with the first board subsidiary surface with the first leg inserted in the first sleeve perforation, the second magnetic core having a second leg, the second magnetic core being brought into contact with the second board
15 subsidiary surface with the second leg inserted in the first sleeve perforation and brought into contact with the first leg.

According to a fourteenth aspect of this invention, there is provided a transformer which
20 comprises a bobbin, first and second coils attached to the bobbin, first and second magnetic cores attached to the bobbin, and first-set and second-set connectors fixed to the bobbin, wherein the bobbin comprises (A) a first board having a first board main surface, a first board
25 subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary

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surface, and second, third, fourth, and fifth board internal surfaces which define second, third, fourth, and fifth board perforations; (C) a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, the first sleeve being integral with the first board with the first sleeve perforation associated with the first board perforation; (D) a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, the second sleeve being integral with the second board with the second sleeve perforation associated with the second board perforation, the second board and the second sleeve perforations receiving the first sleeve; (E) a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, the divider sleeve being integral with the first board with the divider sleeve surrounding the first sleeve and with the divider sleeve interposed between the first and the second board main surfaces so that the divider sleeve surrounds the second sleeve and the third board perforation and is brought into contact with the second board main surface; first and second coupling arms having first and second coupling peak portions, the first and the second coupling arms being integral with the first board, the first and the second coupling arms passing through the fourth and the fifth board perforations with the first and the second coupling peak portions brought into contact with the second board subsidiary surface; the first coil being



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attached around the divider sleeve and being connected to the first-set connectors, the second coil being attached around the second sleeve and being connected to the second-set connectors through the third board

5 perforation; the first magnetic core having a first leg, the first magnetic core being brought into contact with the first board subsidiary surface with the first leg inserted in the first sleeve perforation, the second magnetic core having a second leg, the second magnetic
10 core being brought into contact with the second board subsidiary surface with the second leg inserted in the first sleeve perforation and brought into contact with the first leg.

According to a fifteenth aspect of this
15 invention, there is provided a transformer which comprises a bobbin, first and second coils attached to the bobbin, first and second magnetic cores attached to the bobbin, and first-set and second-set connectors fixed to the bobbin, wherein the bobbin comprises (A) a first
20 board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary
25 surface, second and third board internal surfaces which define second and third board perforations, and first and second ditch surfaces which reach from the second board main surface to the second board subsidiary surface and



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define first and second ditches; (C) a first sleeve
having a first sleeve internal surface which defines a
first sleeve perforation, the first sleeve being integral
with the first board with the first sleeve perforation
5 associated with the first board perforation; (D) a second
sleeve having a second sleeve internal surface which
defines a second sleeve perforation, the second sleeve
being integral with the second board with the second
sleeve perforation associated with the second board
10 perforation, the second board and the second sleeve
perforations receiving the first sleeve; (E) a divider
sleeve having a divider sleeve internal surface which
defines a divider sleeve perforation, the divider sleeve
being integral with the second board with the divider
15 sleeve surrounding the second sleeve and the third board
perforation and with the divider sleeve interposed
between the first and the second board main surfaces so
that the divider sleeve surrounds the first sleeve and is
brought into contact with the first board main surface;
20 and (F) first and second coupling arms having first and
second coupling peak portions, the first and the second
coupling arms being integral with the first board, the
first and the second coupling arms passing through the
first and the second ditches with the first and the
25 second coupling peak portions brought into contact with
the second board subsidiary surface; the first coil being
attached around the divider sleeve and being connected to
the first-set connectors, the second coil being attached



around the second sleeve and being connected to the second-set connectors through the third board perforation; the first magnetic core having a first leg, the first magnetic core being brought into contact with the first board subsidiary surface with the first leg inserted in the first sleeve perforation, and second magnetic core having a second leg, the second magnetic core being brought into contact with the second board subsidiary surface with the second leg inserted in the first sleeve perforation and brought into contact with the first leg.

According to a sixteenth aspect of this invention, there is provided a transformer which comprises a bobbin, first and second coils attached to the bobbin, first and second magnetic cores attached to the bobbin, and first-set and second-set connectors fixed to the bobbin, wherein the bobbin comprises (A) a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation; (B) a second board having a second board main surface opposed to the first board main surface, a second board subsidiary surface, and second and third board internal surfaces which define second and third board perforations, and first and second ditch surfaces which reach from the second board main surface to the second subsidiary surface and define first and second ditches; (C) a first sleeve having a first sleeve internal surface which



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defines a first sleeve perforation, the first sleeve
being integral with the first board with the first sleeve
perforation associated with the first board perforation;
(D) a second sleeve having a second sleeve internal
5 surface which defines a second sleeve perforation, the
second sleeve being integral with the second board with
the second sleeve perforation associated with the second
board perforation, the second board and the second sleeve
perforations receiving the first sleeve; (E) a divider
10 sleeve having a divider sleeve internal surface which
defines a divider sleeve perforation, the divider sleeve
being integral with the first board with the divider
sleeve surrounding the first sleeve and with the divider
sleeve interposed between the first and the second board
15 main surfaces so that the divider sleeve surrounds the
second sleeve and the third board perforation and is
brought into contact with the second board main surface;
and (F) first and second coupling arms having first and
second coupling peak portions, the first and the second
20 coupling arms being integral with the first board, the
first and the second coupling arms passing through the
first and the second ditches with the first and the
second coupling peak portions brought into contact with
the second board subsidiary surface; the first coil being
25 attached around the divider sleeve and being connected to
the first-set connectors, the second coil being attached
around the second sleeve and being connected to the
second-set connectors through the third board



perforation; the first magnetic core having a first leg,
the first magnetic core being brought into contact with
the first board subsidiary surface with the first leg
inserted in the first sleeve perforation, the second
5 magnetic core having a second leg, the second magnetic
core being brought into contact with the second board
subsidiary surface with the second leg inserted in the
first sleeve perforation and brought into contact with
the first leg.

10 Brief Description of the Drawing:

Fig. 1 is a perspective view of a conventional
bobbin;

Fig. 2 is a perspective view of a conventional
transformer;

15 Fig. 3 is an exploded perspective view of a
transformer according to a first embodiment of this
invention;

Fig. 4 is a perspective view of the transformer
illustrated in Fig. 3;

20 Fig. 5 is a partial sectional view of the
transformer illustrated in Fig. 4;

Fig. 6 is an exploded sectional view of the
transformer illustrated in Fig. 4;

25 Fig. 7 is a sectional view taken along a line 7-7
in Fig. 4;

Fig. 8 is an exploded perspective view of a
transformer according to a second embodiment of this
invention;



Fig. 9 is an exploded sectional view of the transformer illustrated in Fig. 8;

Fig. 10 is an exploded perspective view of a transformer according to a third embodiment of this invention; and

Fig. 11 is a perspective view of the transformer illustrated in Fig. 10.

Description of the Preferred Embodiment:

Referring to Fig. 1, a conventional bobbin will first be described for a better understanding of this invention. The conventional bobbin comprises a sleeve 21, a plurality of divider plates 23, and first and second end plates 25 and 27. The sleeve 21 has a sleeve internal surface 28 which defines a sleeve perforation. The divider plates 23 are attached to the sleeve with a space left between two adjacent ones of the divider plates 23 and with the divider plates 23 perpendicular to the sleeve 21. The first and the second end plates 25 and 27 are attached to side ends of the sleeve 21 with a space left between one of the divider plates 23 and each of the first and the second end plates 25 and 27.

Referring to Fig. 2, a conventional transformer will be described for a better understanding of this invention. Similar parts are designated by like reference numerals.

The conventional transformer comprises the bobbin, first and second coils 29 and 31 attached to the bobbin, a magnetic core (not shown) attached to the



bobbin, and first-set and second-set connectors 33 and 35 fixed to the bobbin. The first and the second coils 29 and 31 are attached around the sleeve 21 between the divider plates 23. The first and the second coils 29 and 31 are connected to the first-set and the second-set connectors 33 and 35, respectively.

In the bobbin and the transformer, inasmuch as the divider plates 23 do not surround the first coil 29 or the second coil 31, it is hardly possible to reliably insulate the first coil 29 from the second coil 31 by the divider plates 23. Also, inasmuch as the divider plates 23 are perpendicular to the sleeve 21 and are high in height, the bobbin and the transformer are high in height.

Referring to Figs. 3 to 7, the description will proceed to a transformer according to a first embodiment of this invention.

The transformer comprises a bobbin 41, first and second coils 43 and 45 attached to the bobbin 41, first and second magnetic cores 47 and 49 attached to the bobbin 41, and first-set and second-set connectors 51 and 53 fixed to the bobbin 41.

The bobbin 41 is made of insulating material. The bobbin 41 comprises first and second boards 55 and 57, first and second sleeves 59 and 61, and a divider sleeve 63.

The first board 55 has a first board main surface 65, a first board subsidiary surface 67, and a first



board internal surface 69 which defines a first board perforation. The second board 57 has a second board main surface 71 opposed to the first board main surface 65, a second board subsidiary surface 73, and second and third
5 board internal surfaces 75 and 77 which define second and third board perforations.

The first sleeve 59 has a first sleeve internal surface 79 which defines a first sleeve perforation. The first sleeve 59 is integral with the first board 55 with
10 the first sleeve perforation associated with the first board perforation. The second sleeve 61 has a second sleeve internal surface 81 which defines a second sleeve perforation. The second sleeve 61 is integral with the second board 57 with the second sleeve perforation
15 associated with the second board perforation. The second board and the second sleeve perforations receive the first sleeve 59.

The divider sleeve 63 has a divider sleeve internal surface 83 which defines a divider sleeve
20 perforation. The divider sleeve 63 is integral with the second board 57 with the divider sleeve 63 surrounding the second sleeve 61 and the third board perforation and with the divider sleeve 63 interposed between the first and the second board main surfaces 65 and 71 so that the
25 divider sleeve 63 surrounds the first sleeve 59. The divider sleeve 63 is welded to the first board main surface 65. The divider sleeve 63 may be glued to the first board main surface 65.

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The first coil 43 is attached around the divider sleeve 63 and is connected to the first-set connectors 51. The second coil 45 is attached around the second sleeve 61 and is connected to the second-set connectors 53 through the third board perforation.

The first magnetic core 47 has a first leg 85. The first magnetic core 47 is brought into contact with the first board subsidiary surface 67 with the first leg 85 inserted in the first sleeve perforation. The second magnetic core 49 has a second leg 87. The second magnetic core 49 is brought into contact with the second board subsidiary surface 73 with the second leg 87 inserted in the first sleeve perforation and brought into contact with the first leg 85. A first end portion of the first magnetic core 47 is brought into contact with a second end portion of the second magnetic core 49 and is glued to the second end portion.

Referring to Figs. 8 and 9, the description will proceed to a transformer according to a second embodiment of this invention. The transformer comprises similar parts designated by like reference numerals.

The divider sleeve 63 is integral with the first board 55 with the divider sleeve 63 surrounding the first sleeve 59. The divider sleeve 63 further has a contact peak portion 89 which is brought into contact with the second board main surface 71. The divider sleeve 63 surrounds the second sleeve 61 and the third board perforation. The second board 57 has first side surfaces

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91 to which the first-set connectors 53 are fixed. The third board internal surface 75 reaches the first side surfaces 91.

The second board 57 further has fourth and fifth board internal surfaces 93 and 95 which define fourth and fifth board perforations. First and second coupling arms 97 and 99 have first and second coupling peak portions and are integral with the first board 55. The first and the second coupling arms 97 and 99 pass through the fourth and the fifth board perforations with the first and the second peak portions brought into contact with the second board subsidiary surface 73.

Referring to Figs. 10 and 11, the description will proceed to a transformer according to a third embodiment of this invention. The transformer comprises similar parts designated by like reference numerals.

The second board 57 has first and second ditch surfaces 101 and 103 which reach from the second board main surface 71 to the second board subsidiary surface 73 and which define first and second ditches. The first and the second coupling arms 97 and 99 pass through the first and the second ditches with the first and the second coupling peak portions brought into contact with the second board subsidiary surface 73. The second board 57 has a locating lug 105 which is inserted in the third board perforation.

While this invention has thus far been described in conjunction with a few preferred embodiments thereof,



it will now be readily possible for those skilled in the art to put this invention into practice in various other manners. For example, in Figs. 3 to 7, the divider sleeve 63 may be integral with the first board 55 with
5 the divider sleeve 63 surrounding the first sleeve 59. In this event, the divider sleeve 63 is interposed between the first and the second board main surfaces 65 and 71 so that the divider sleeve 63 surrounds the second sleeve 61 and the third board perforation. The divider
10 sleeve 63 is welded or glued to the second board main surface 71.

In Figs. 8 to 11, the divider sleeve 63 may be integral with the second board 57 with the divider sleeve 63 surrounding the second sleeve 61 and the third board
15 perforation. In this event, the divider sleeve 63 is interposed between the first and the second board main surfaces 65 and 71 so that the divider sleeve 63 surrounds the first sleeve 59. The divider sleeve 63 has the contact peak portion 89 which is brought into contact
20 with the first board main surface 65.

Also, the divider sleeve 63 may have not the contact peak portion 89. In this event, the divider sleeve 63 is directly brought into contact with the first or the second board main surface 65 or 71.



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WHAT IS CLAIMED IS:

1. A bobbin comprising:

a first board having a first board main surface and a first board internal surface which defines a first board perforation;

5 a second board having a second board main surface opposed to said first board main surface and second and third board internal surfaces which define second and third board perforations;

a first sleeve having a first sleeve internal
10 surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

a second sleeve having a second sleeve internal
15 surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said second sleeve perforations receiving said first sleeve;
20 and

a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said second board with said divider sleeve surrounding said second sleeve and
25 said third board perforation and with said divider sleeve interposed between said first and said second board main





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(Claim 1 continued)

surfaces so that said divider sleeve surrounds said first sleeve, said divider sleeve being welded to said first board main surface.

2. A bobbin comprising:

a first board having a first board main surface and a first board internal surface which defines a first board perforation;

5 a second board having a second board main surface opposed to said first board main surface and second and third board internal surfaces which define second and third board perforations;

a first sleeve having a first sleeve internal
10 surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

a second sleeve having a second sleeve internal
15 surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said second sleeve perforations receiving said first sleeve;

20 and

a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said second board with said divider sleeve surrounding said second sleeve and





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(Claim 2 continued)

25 said third board perforation and with said divider sleeve interposed between said first and said second board main surfaces so that said divider sleeve surrounds said first sleeve, said divider sleeve being glued to said first board main surface.

3. A bobbin comprising:

a first board having a first board main surface and a first board internal surface which defines a first board perforation;

5 a second board having a second board main surface opposed to said first board main surface and second and third board internal surfaces which define second and third board perforations;

a first sleeve having a first sleeve internal
10 surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

a second sleeve having a second sleeve internal
15 surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said second sleeve perforations receiving said first sleeve;

20 and

a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said





(Claim 3 continued)

divider sleeve being integral with said first board with
said divider sleeve surrounding said first sleeve and
25 with said divider sleeve interposed between said first
and said second board main surfaces so that said divider
sleeve surrounds said second sleeve and said third board
perforation, said divider sleeve being welded to said
second board main surface.

4. A bobbin comprising:

a first board having a first board main surface
and a first board internal surface which defines a first
board perforation;

5 a second board having a second board main surface
opposed to said first board main surface and second and
third board internal surfaces which define second and
third board perforations;

a first sleeve having a first sleeve internal
10 surface which defines a first sleeve perforation, said
first sleeve being integral with said first board with
said first sleeve perforation associated with said first
board perforation;

a second sleeve having a second sleeve internal
15 surface which defines a second sleeve perforation, said
second sleeve being integral with said second board with
said second sleeve perforation associated with said
second board perforation, said second board and said
second sleeve perforations receiving said first sleeve;

20 and





(Claim 4 continued)

a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said first board with said divider sleeve surrounding said first sleeve and
25 with said divider sleeve interposed between said first and said second board main surfaces so that said divider sleeve surrounds said second sleeve and said third board perforation, said divider sleeve being glued to said second board main surface.

5. A bobbin comprising:

a first board having a first board main surface and a first board internal surface which defines a first board perforation;

5 a second board having a second board main surface opposed to said first board main surface, a second board subsidiary surface, and second, third, fourth, and fifth board internal surfaces which define second, third, fourth, and fifth board perforations;

10 a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

15 a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said





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(Claim 5 continued)

second board perforation, said second board and said
20 second sleeve perforations receiving said first sleeve;
a divider sleeve having a divider sleeve internal
surface which defines a divider sleeve perforation, said
divider sleeve being integral with said second board with
said divider sleeve surrounding said second sleeve and
25 said third board perforation and with said divider sleeve
interposed between said first and said second board main
surfaces so that said divider sleeve surrounds said first
sleeve and is brought into contact with said first board
main surface; and
30 first and second coupling arms having first and
second coupling peak portions, said first and said second
coupling arms being integral with said first board, said
first and said second coupling arms passing through said
fourth and said fifth board perforations with said first
35 and said second coupling peak portions brought into
contact with said second board subsidiary surface.

6. A bobbin as claimed in Claim 5, said divider
sleeve further having a contact peak portion which is
brought into contact with said first board main surface.

7. A bobbin comprising:

a first board having a first board main surface
and a first board internal surface which defines a first
board perforation;

5 a second board having a second board main surface
opposed to said first board main surface, a second board





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(Claim 7 continued)

subsidiary surface, and second, third, fourth, and fifth board internal surfaces which define second, third, fourth, and fifth board perforations;

10 a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

15 a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said
20 second sleeve perforations receiving said first sleeve;

 a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said first board with said divider sleeve surrounding said first sleeve and
25 with said divider sleeve interposed between said first and said second board main surfaces so that said divider sleeve surrounds said second sleeve and said third board perforation and is brought into contact with said second board main surface; and

30 first and second coupling arms having first and second coupling peak portions, said first and said second coupling arms being integral with said first board, said first and said second coupling arms passing through said





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(Claim 7 twice continued)

fourth and said fifth board perforations with said first
35 and said second coupling peak portions brought into
contact with said second board subsidiary surface.

8. A bobbin as claimed in Claim 7, said divider
sleeve further having a contact peak portion which is
brought into contact with said second board main surface.

9. A bobbin comprising:

a first board having a first board main surface
and a first board internal surface which defines a first
board perforation;

5 a second board having a second board main surface
opposed to said first board main surface, a second board
subsidiary surface, second and third board internal
surfaces which define second and third board
perforations, and first and second ditch surfaces which
10 reach from said second board main surface to said second
board subsidiary surface and define first and second
ditches;

a first sleeve having a first sleeve internal
surface which defines a first sleeve perforation, said
15 first sleeve being integral with said first board with
said first sleeve perforation associated with said first
board perforation;

a second sleeve having a second sleeve internal
surface which defines a second sleeve perforation, said
20 second sleeve being integral with said second board with
said second sleeve perforation associated with said





(Claim 9 continued)

second board perforation, said second board and said second sleeve perforations receiving said first sleeve;

25 a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said second board with said divider sleeve surrounding said second sleeve and said third board perforation and with said divider sleeve interposed between said first and said second board main
30 surfaces so that said divider sleeve surrounds said first sleeve and is brought into contact with said first board main surface; and

first and second coupling arms having first and second coupling peak portions, said first and said second
35 coupling arms being integral with said first board, said first and said second coupling arms passing through said first and said second ditches with said first and said second coupling peak portions brought into contact with said second board subsidiary surface.

10. A bobbin as claimed in Claim 9, said divider sleeve further having a contact peak portion which is brought into contact with said first board main surface.

11. A bobbin comprising:

a first board having a first board main surface and a first board internal surface which defines a first board perforation;

5 a second board having a second board main surface opposed to said first board main surface, a second board





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(Claim 11 continued)

subsidiary surface, and second and third board internal surfaces which define second and third board perforations, and first and second ditch surfaces which
10 reach from said second board main surface to said second board subsidiary surface and define first and second ditches;

a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, said
15 first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, said
20 second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said second sleeve perforations receiving said first sleeve;
and

25 a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said first board with said divider sleeve surrounding said first sleeve and with said divider sleeve interposed between said first
30 and said second board main surfaces so that said divider sleeve surrounds said second sleeve and said third board perforation and is brought into contact with said second board main surface; and





(Claim 11 twice continued)

first and second coupling arms having first and
35 second coupling peak portions, said first and said second
coupling arms being integral with said first board, said
first and said second coupling arms passing through said
first and said second ditches with said first and said
second coupling peak portions brought into contact with
40 said second board subsidiary surface.

12. A bobbin as claimed in Claim 11, said
divider sleeve further having a contact peak portion
which is brought into contact with said second board main
surface.

13. A transformer comprising a bobbin, first and
second coils attached to said bobbin, first and second
magnetic cores attached to said bobbin, and first-set and
second-set connectors fixed to said bobbin, wherein:

5 said bobbin comprises:

a first board having a first board main surface,
a first board subsidiary surface, and a first board
internal surface which defines a first board perforation;

a second board having a second board main surface
10 opposed to said first board main surface, a second board
subsidiary surface, and second and third board internal
surfaces which define second and third board
perforations;

a first sleeve having a first sleeve internal
15 surface which defines a first sleeve perforation, said
first sleeve being integral with said first board with





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(Claim 13 continued)

said first sleeve perforation associated with said first board perforation;

20 a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said second sleeve perforations receiving said first sleeve;

25 and

a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said second board with said divider sleeve surrounding said second sleeve and

30 said third board perforation and with said divider sleeve interposed between said first and said second board main surfaces so that said divider sleeve surrounds said first sleeve, said divider sleeve being welded to said first board main surface;

35 said first coil being attached around said divider sleeve and being connected to said first-set connectors, said second coil being attached around said second sleeve and being connected to said second-set connectors through said third board perforation;

40 said first magnetic core having a first leg, said first magnetic core being brought into contact with said first board subsidiary surface with said first leg inserted in said first sleeve perforation, said second





(Claim 13 twice continued)

magnetic core having a second leg, said second magnetic
45 core being brought into contact with said second board
subsidiary surface with said second leg inserted in said
first sleeve perforation and brought into contact with
said first leg.

14. A transformer comprising a bobbin, first and
second coils attached to said bobbin, first and second
magnetic cores attached to said bobbin, and first-set and
second-set connectors fixed to said bobbin, wherein:

5 said bobbin comprises:

a first board having a first board main surface,
a first board subsidiary surface, and a first board
internal surface which defines a first board perforation;

a second board having a second board main surface
10 opposed to said first board main surface, a second board
subsidiary surface, and second and third board internal
surfaces which define second and third board
perforations;

a first sleeve having a first sleeve internal
15 surface which defines a first sleeve perforation, said
first sleeve being integral with said first board with
said first sleeve perforation associated with said first
board perforation;

a second sleeve having a second sleeve internal
20 surface which defines a second sleeve perforation, said
second sleeve being integral with said second board with
said second sleeve perforation associated with said





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(Claim 14 continued)

second board perforation, said second board and said
second sleeve perforations receiving said first sleeve;

25 and

a divider sleeve having a divider sleeve internal
surface which defines a divider sleeve perforation, said
divider sleeve being integral with said second board with
said divider sleeve surrounding said second sleeve and
30 said third board perforation and with said divider sleeve
interposed between said first and said second board main
surfaces so that said divider sleeve surrounds said first
sleeve, said divider sleeve being glued to said first
board main surface;

35 said first coil being attached around said
divider sleeve and being connected to said first-set
connectors, said second coil being attached around said
second sleeve and being connected to said second-set
connectors through said third board perforation;

40 said first magnetic core having a first leg, said
first magnetic core being brought into contact with said
first board subsidiary surface with said first leg
inserted in said first sleeve perforation, said second
magnetic core having a second leg, said second magnetic
45 core being brought into contact with said second board
subsidiary surface with said second leg inserted in said
first sleeve perforation and brought into contact with
said first leg.





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15. A transformer comprising a bobbin, first and second coils attached to said bobbin, first and second magnetic cores attached to said bobbin, and first-set and second-set connectors fixed to said bobbin, wherein:

5 said bobbin comprises:

 a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation;

 a second board having a second board main surface
10 opposed to said first board main surface, a second board subsidiary surface, and second and third board internal surfaces which define second and third board perforations;

 a first sleeve having a first sleeve internal
15 surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

 a second sleeve having a second sleeve internal
20 surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said second sleeve perforations receiving said first sleeve;

25 and

 a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said first board with



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(Claim 15 continued)

30 said divider sleeve surrounding said first sleeve and
with said divider sleeve interposed between said first
and said second board main surfaces so that said divider
sleeve surrounds said second sleeve and said third board
perforation, said divider sleeve being welded to said
second board main surface;

35 said first coil being attached around said
divider sleeve and being connected to said first-set
connectors, said second coil being attached around said
second sleeve and being connected to said second-set
connectors through said third board perforation;

40 said first magnetic core having a first leg, said
first magnetic core being brought into contact with said
first board subsidiary surface with said first leg
inserted in said first sleeve perforation, said second
magnetic core having a second leg, said second magnetic
45 core being brought into contact with said second board
subsidiary surface with said second leg inserted in said
first sleeve perforation and brought into contact with
said first leg.

16. A transformer comprising a bobbin, first and
second coils attached to said bobbin, first and second
magnetic cores attached to said bobbin, and first-set and
second-set connectors fixed to said bobbin, wherein:

5 said bobbin comprises:

a first board having a first board main surface,
a first board subsidiary surface, and a first board





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(Claim 16 continued)

internal surface which defines a first board perforation;

10 a second board having a second board main surface
opposed to said first board main surface, a second board
subsidiary surface, and second and third board internal
surfaces which define second and third board
perforations;

15 a first sleeve having a first sleeve internal
surface which defines a first sleeve perforation, said
first sleeve being integral with said first board with
said first sleeve perforation associated with said first
board perforation;

20 a second sleeve having a second sleeve internal
surface which defines a second sleeve perforation, said
second sleeve being integral with said second board with
said second sleeve perforation associated with said
second board perforation, said second board and said
second sleeve perforations receiving said first sleeve;

25 and

a divider sleeve having a divider sleeve internal
surface which defines a divider sleeve perforation, said
divider sleeve being integral with said first board with
said divider sleeve surrounding said first sleeve and
30 with said divider sleeve interposed between said first
and said second board main surfaces so that said divider
sleeve surrounds said second sleeve and said third board
perforation, said divider sleeve being glued to said
second board main surface;





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(Claim 16 twice continued)

35 said first coil being attached around said
divider sleeve and being connected to said first-set
connectors, said second coil being attached around said
second sleeve and being connected to said second-set
connectors through said third board perforation;

40 said first magnetic core having a first leg, said
first magnetic core being brought into contact with said
first board subsidiary surface with said first leg
inserted in said first sleeve perforation, said second
magnetic core having a second leg, said second magnetic
45 core being brought into contact with said second board
subsidiary surface with said second leg inserted in said
first sleeve perforation and brought into contact with
said first leg.

17. A transformer comprising a bobbin, first and
second coils attached to said bobbin, first and second
magnetic cores attached to said bobbin, and first-set and
second-set connectors fixed to said bobbin, wherein:

5 said bobbin comprises:

 a first board having a first board main surface,
a first board subsidiary surface, and a first board
internal surface which defines a first board perforation;

 a second board having a second board main surface
10 opposed to said first board main surface, a second board
subsidiary surface, and second, third, fourth, and fifth
board internal surfaces which define second, third,
fourth, and fifth board perforations;



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(Claim 17 continued)

15 a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first board perforation;

20 a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said second board perforation, said second board and said second sleeve perforations receiving said first sleeve;

25 a divider sleeve having a divider sleeve internal surface which defines a divider sleeve perforation, said divider sleeve being integral with said second board with said divider sleeve surrounding said second sleeve and said third board perforation and with said divider sleeve
30 interposed between said first and said second board main surfaces so that said divider sleeve surrounds said first sleeve and is brought into contact with said first board main surface; and

35 first and second coupling arms having first and second coupling peak portions, said first and said second coupling arms being integral with said first board, said first and said second coupling arms passing through said fourth and said fifth board perforations with said first and said second coupling peak portions brought into
40 contact with said second board subsidiary surface;





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(Claim 17 twice continued)

said first coil being attached around said divider sleeve and being connected to said first-set connectors, said second coil being attached around said second sleeve and being connected to said second-set
45 connectors through said third board perforation;

said first magnetic core having a first leg, said first magnetic core being brought into contact with said first board subsidiary surface with said first leg inserted in said first sleeve perforation, said second
50 magnetic core having a second leg, said second magnetic core being brought into contact with said second board subsidiary surface with said second leg inserted in said first sleeve perforation and brought into contact with said first leg.

18. A transformer as claimed in Claim 17, said divider sleeve further having a contact peak portion which is brought into contact with said first board main surface.

19. A transformer comprising a bobbin, first and second coils attached to said bobbin, first and second magnetic cores attached to said bobbin, and first-set and second-set connectors fixed to said bobbin, wherein:

5 said bobbin comprises:

a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation;





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(Claim 19 continued)

a second board having a second board main surface
10 opposed to said first board main surface, a second board
subsidiary surface, and second, third, fourth, and fifth
board internal surfaces which define second, third,
fourth, and fifth board perforations;

a first sleeve having a first sleeve internal
15 surface which defines a first sleeve perforation, said
first sleeve being integral with said first board with
said first sleeve perforation associated with said first
board perforation;

a second sleeve having a second sleeve internal
20 surface which defines a second sleeve perforation, said
second sleeve being integral with said second board with
said second sleeve perforation associated with said
second board perforation, said second board and said
second sleeve perforations receiving said first sleeve;

25 a divider sleeve having a divider sleeve internal
surface which defines a divider sleeve perforation, said
divider sleeve being integral with said first board with
said divider sleeve surrounding said first sleeve and
with said divider sleeve interposed between said first
30 and said second board main surfaces so that said divider
sleeve surrounds said second sleeve and said third board
perforation and is brought into contact with said second
board main surface;

first and second coupling arms having first and
35 second coupling peak portions, said first and said second





(Claim 19 twice continued)

coupling arms being integral with said first board, said first and said second coupling arms passing through said fourth and said fifth board perforations with said first and said second coupling peak portions brought into
40 contact with said second board subsidiary surface;
said first coil being attached around said divider sleeve and being connected to said first-set connectors, said second coil being attached around said second sleeve and being connected to said second-set
45 connectors through said third board perforation;
said first magnetic core having a first leg, said first magnetic core being brought into contact with said first board subsidiary surface with said first leg inserted in said first sleeve perforation, said second
50 magnetic core having a second leg, said second magnetic core being brought into contact with said second board subsidiary surface with said second leg inserted in said first sleeve perforation and brought into contact with said first leg.

20. A transformer as claimed in Claim 19, said divider sleeve further having a contact peak portion which is brought into contact with said second board main surface.

21. A transformer comprising a bobbin, first and second coils attached to said bobbin, first and second magnetic cores attached to said bobbin, and first-set and second-set connectors fixed to said bobbin, wherein:





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(Claim 21 continued)

5 said bobbin comprises:

 a first board having a first board main surface,
a first board subsidiary surface, and a first board
internal surface which defines a first board perforation;

 a second board having a second board main surface
10 opposed to said first board main surface, a second board
subsidiary surface, second and third board internal
surfaces which define second and third board
perforations, and first and second ditch surfaces which
reach from said second board main surface to said second
15 board subsidiary surface and define first and second
ditches;

 a first sleeve having a first sleeve internal
surface which defines a first sleeve perforation, said
first sleeve being integral with said first board with
20 said first sleeve perforation associated with said first
board perforation;

 a second sleeve having a second sleeve internal
surface which defines a second sleeve perforation, said
second sleeve being integral with said second board with
25 said second sleeve perforation associated with said
second board perforation, said second board and said
second sleeve perforations receiving said first sleeve;

 a divider sleeve having a divider sleeve internal
surface which defines a divider sleeve perforation, said
30 divider sleeve being integral with said second board with
said divider sleeve surrounding said second sleeve and





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(Claim 21 twice continued)

said third board perforation and with said divider sleeve interposed between said first and said second board main surfaces so that said divider sleeve surrounds said first
35 sleeve and is brought into contact with said first board main surface; and

first and second coupling arms having first and second coupling peak portions, said first and said second coupling arms being integral with said first board, said
40 first and said second coupling arms passing through said first and said second ditches with said first and said second coupling peak portions brought into contact with said second board subsidiary surface;

said first coil being attached around said
45 divider sleeve and being connected to said first-set connectors, said second coil being attached around said second sleeve and being connected to said second-set connectors through said third board perforation;

said first magnetic core having a first leg,
50 said first magnetic core being brought into contact with said first board subsidiary surface with said first leg inserted in said first sleeve perforation, said second magnetic core having a second leg, said second magnetic core being brought into contact with said second board
55 subsidiary surface with said second leg inserted in said first sleeve perforation and brought into contact with said first leg.





22. A transformer as claimed in Claim 21, said divider sleeve further having a contact peak portion which is brought into contact with said first board main surface.

23. A transformer comprising a bobbin, first and second coils attached to said bobbin, first and second magnetic cores attached to said bobbin, and first-set and second-set connectors fixed to said bobbin, wherein:

5 said bobbin comprises:

 a first board having a first board main surface, a first board subsidiary surface, and a first board internal surface which defines a first board perforation;

 a second board having a second board main surface
10 opposed to said first board main surface, a second board subsidiary surface, and second and third board internal surfaces which define second and third board perforations, and first and second ditch surfaces which reach from said second board main surface to said second
15 subsidiary surface and define first and second ditches;

 a first sleeve having a first sleeve internal surface which defines a first sleeve perforation, said first sleeve being integral with said first board with said first sleeve perforation associated with said first
20 board perforation;

 a second sleeve having a second sleeve internal surface which defines a second sleeve perforation, said second sleeve being integral with said second board with said second sleeve perforation associated with said



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(Claim 23 continued)

25 second board perforation, said second board and said
second sleeve perforations receiving said first sleeve;
a divider sleeve having a divider sleeve internal
surface which defines a divider sleeve perforation, said
divider sleeve being integral with said first board with
30 said divider sleeve surrounding said first sleeve and
with said divider sleeve interposed between said first
and said second board main surfaces so that said divider
sleeve surrounds said second sleeve and said third board
perforation and is brought into contact with said second
35 board main surface; and
first and second coupling arms having first and
second coupling peak portions, said first and said second
coupling arms being integral with said first board, said
first and said second coupling arms passing through said
40 first and said second ditches with said first and said
second coupling peak portions brought into contact with
said second board subsidiary surface;
said first coil being attached around said
divider sleeve and being connected to said first-set
45 connectors, said second coil being attached around said
second sleeve and being connected to said second-set
connectors through said third board perforation;
said first magnetic core having a first leg, said
first magnetic core being brought into contact with said
50 first board subsidiary surface with said first leg
inserted in said first sleeve perforation, said second





(Claim 23 twice continued)

magnetic core having a second leg, said second magnetic
core being brought into contact with said second board
subsidiary surface with said second leg inserted in said
55 first sleeve perforation and brought into contact with
said first leg.

24. A transformer as claimed in Claim 23, said
divider sleeve further having a contact peak portion
which is brought into contact with said second board main
surface.



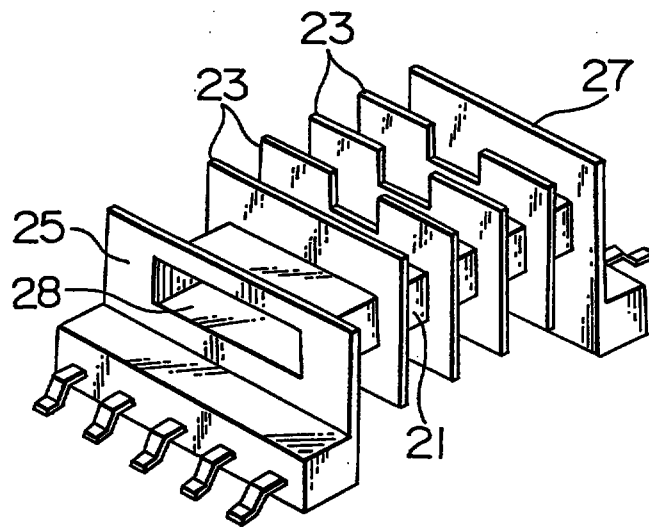


FIG. 1 PRIOR ART

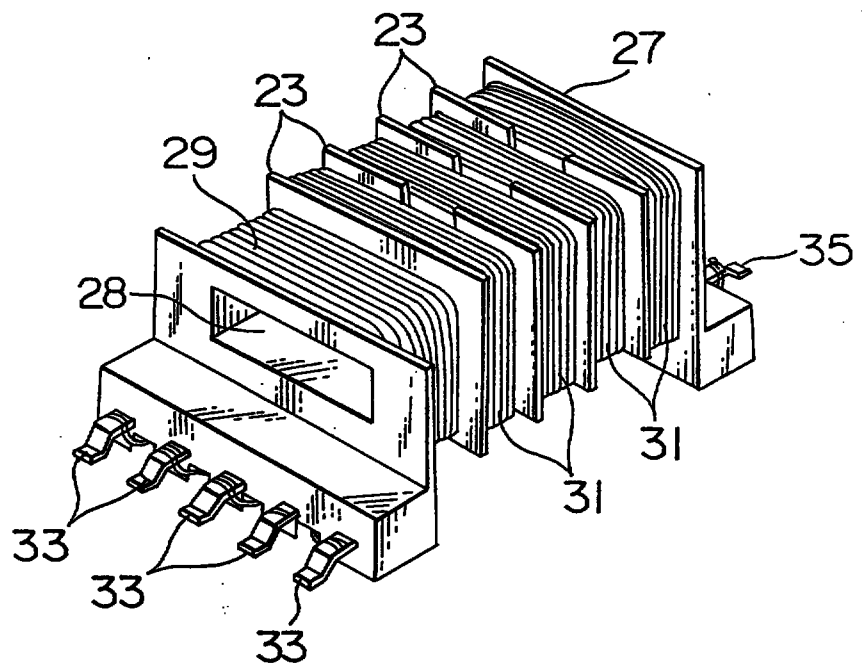


FIG. 2 PRIOR ART

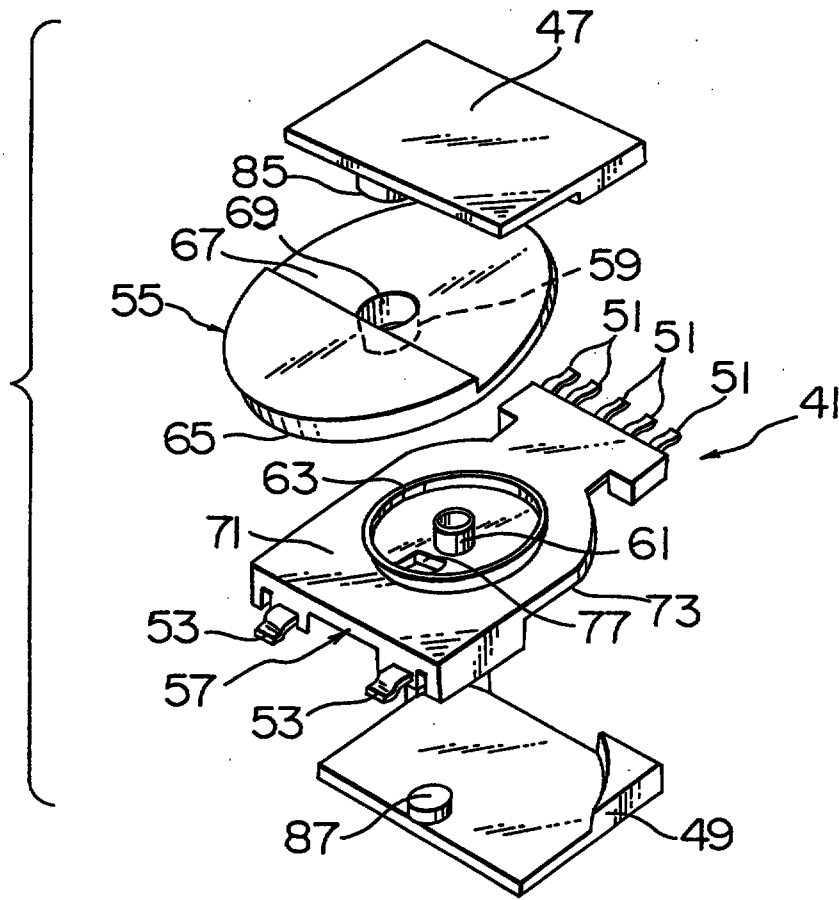


FIG. 3

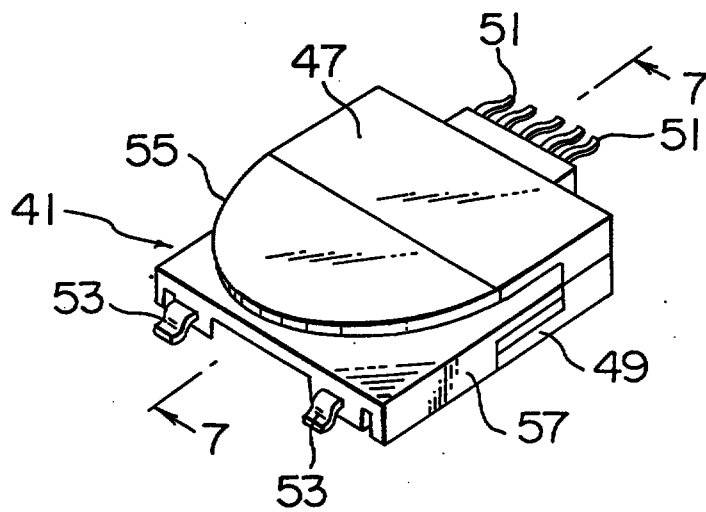


FIG. 4

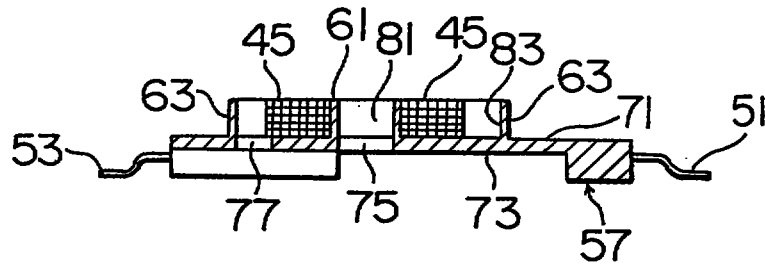


FIG. 5

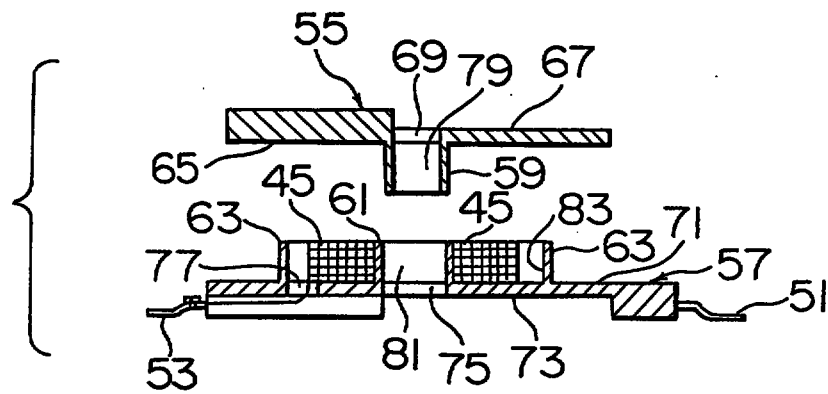


FIG. 6

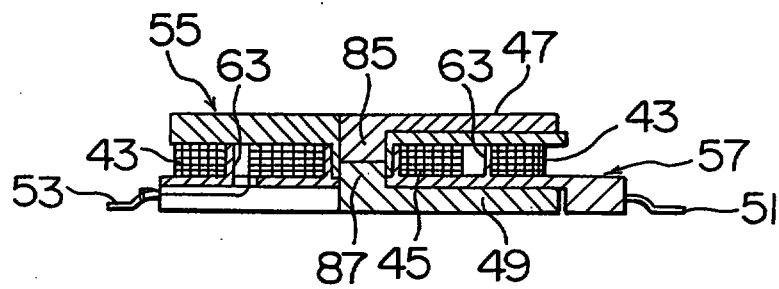


FIG. 7

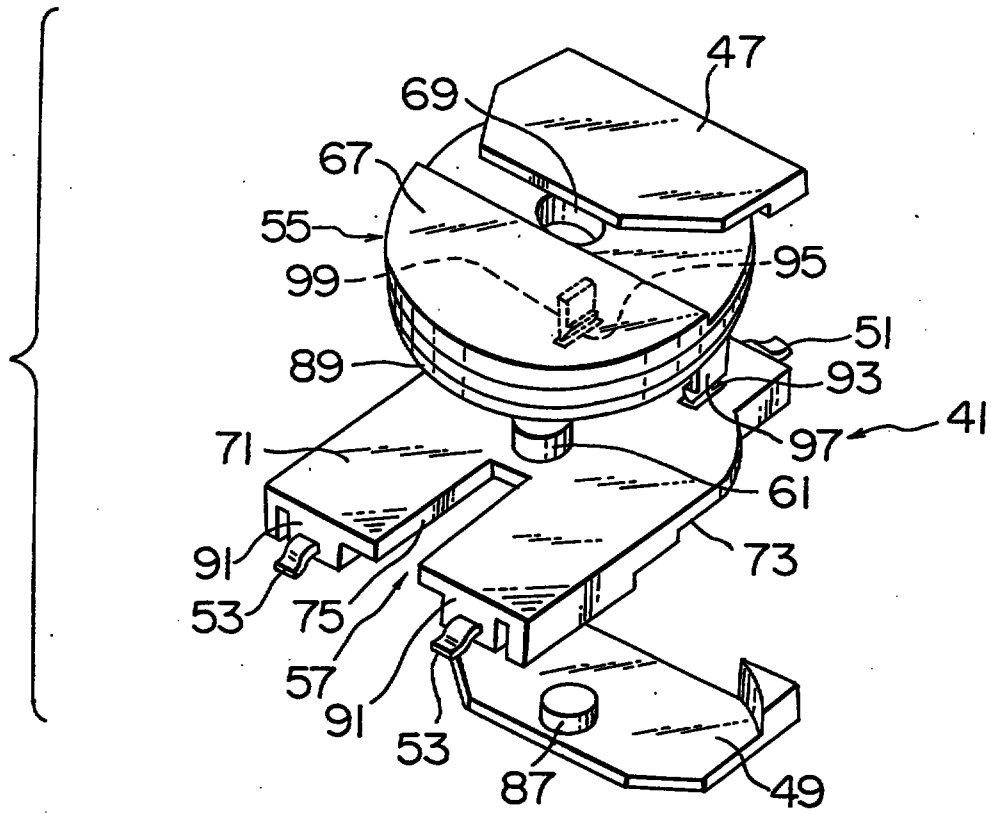


FIG. 8

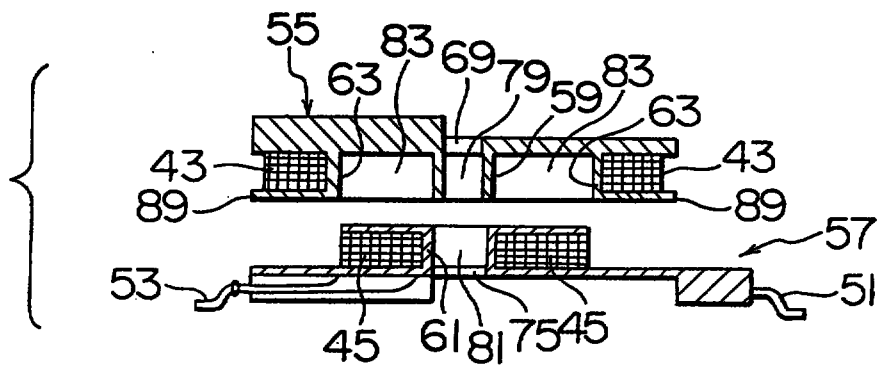


FIG. 9

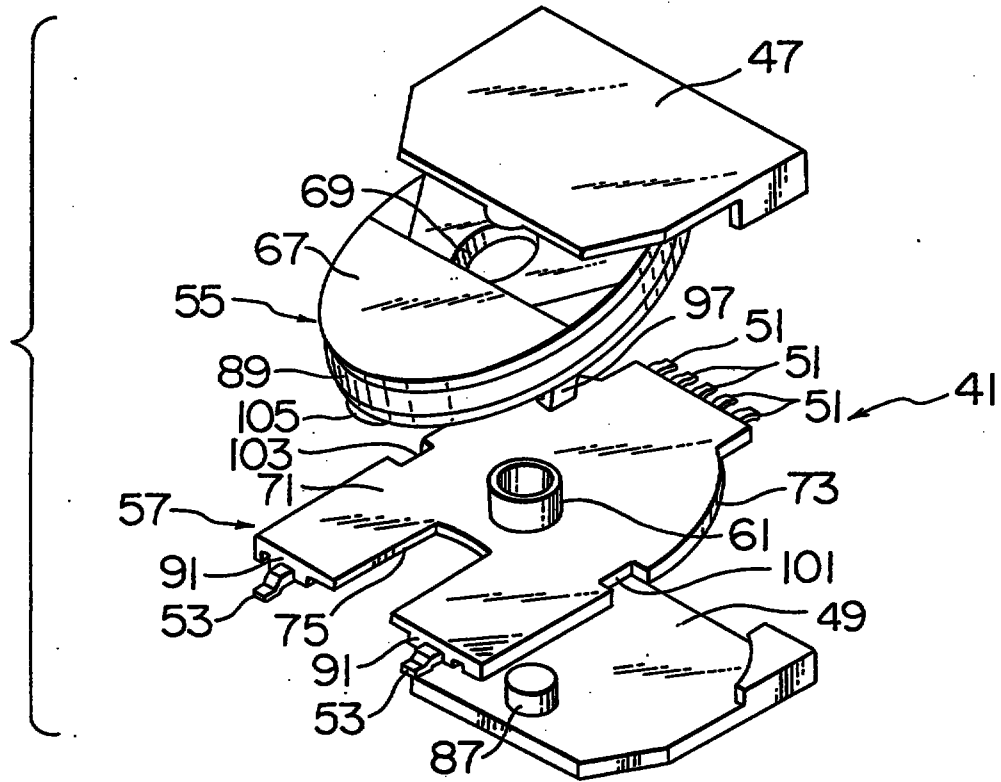


FIG. 10

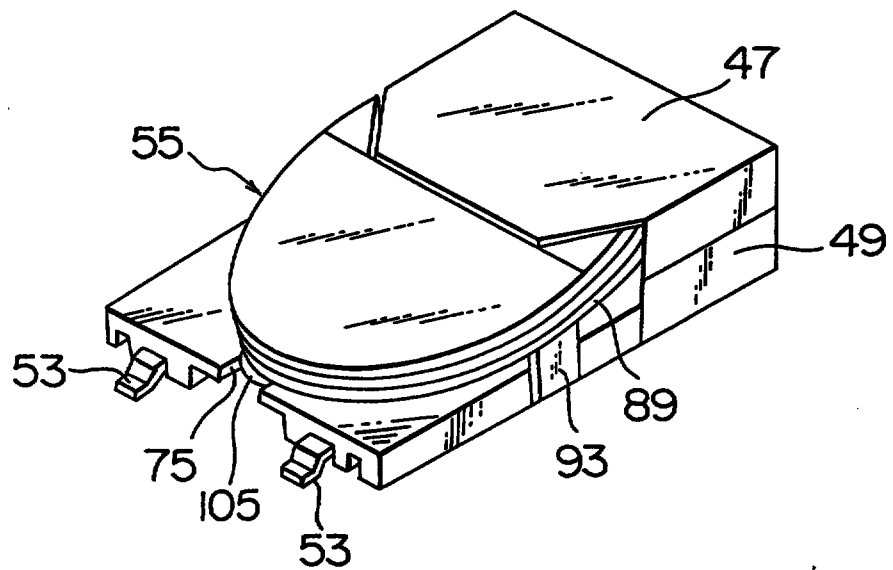


FIG. 11

ABSTRACT

A BOBBIN CAPABLE OF RELIABLY INSULATING A FIRST COIL FROM A SECOND COIL

In a bobbin having a first board (55) and a second board (57) opposed to the first board, first and second sleeves (59, 61) are integral with the first and the second boards, respectively. The first sleeve is
5 inserted in the second sleeve. A divider sleeve (63) is integrated with the second board with the divider sleeve surrounding the second sleeve and a first perforation of the second board. The divider sleeve is interposed between the first and the second board with the divider
10 sleeve surrounding the first sleeve and with the divider sleeve welded or glued to the first board. First-set and second-set connectors (51, 53) are fixed to the bobbin. A first coil (43) is attached around the divider sleeve and is connected to the first-set connectors. A second
15 coil (45) is attached around the second sleeve and is connected to the second-set connectors through the first perforation. The divider sleeve may be integral with the first board. First and second coupling arms (97, 99) may be integral with the first board and may pass second and
20 third perforations of the second board with the coupling peak portions of the first and the second coupling arms brought into contact with a surface of the second board. The first and the second coupling arms may pass first and second ditches of the second board. In this event, the
25 divider sleeve is brought into contact with the first or the second board.

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**A BOBBIN CAPABLE OF RELIABLY INSULATING
A FIRST COIL FROM A SECOND COIL**

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Background of the Invention:

This invention relates to a transformer.

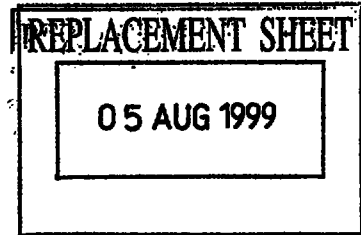
A conventional transformer comprises the bobbin, first and second coils attached to the bobbin, a magnetic core attached to the bobbin, and first-set and second-set connectors. The first and the second coils are attached around the sleeve between the divider plates. The first and the second coils are connected to the first-set and the second-set converters, respectively.

In the bobbin and the transformer, it is hardly possible to reliably insulate the first coil from the second coil by the divider plates. This is because the divider plates do not surround the first coil or the second coil. Also, inasmuch as the divider plates are perpendicular to the sleeve and are high in height, the bobbin and the transformer are high in height.

The EP-A-0 325 467 discloses a transformer according to the preambles of independent claims 1 to 3.

It is an object of this invention to provide a transformer which is easy and cheap to manufacture and to assemble.

The object of the invention is solved by a transformer according to one of claims 1 to 3.



Brief Description of the Drawing:

Fig. 1 is a perspective view of a conventional bobbin;

Fig. 2 is a perspective view of a conventional transformer;

Fig. 3 is an exploded perspective view of a transformer according to a first embodiment of this invention;

Fig. 4 is a perspective view of the transformer illustrated in Fig. 3;

Fig. 5 is a partial sectional view of the transformer illustrated in Fig. 4;

Fig. 6 is an exploded sectional view of the transformer illustrated in Fig. 4;

Fig. 7 is a sectional view taken along a line 7-7 in Fig. 4;

Fig. 8 is an exploded perspective view of a transformer for describing the technical background of this invention;

Fig. 9 is an exploded sectional view of the transformer illustrated in Fig. 8;

Fig. 10 is an exploded perspective view of a transformer for describing the technical background of this invention; and

Fig. 11 is a perspective view of the transformer illustrated in Fig. 10.

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Description of the Preferred Embodiment :

Referring to Fig. 1, a conventional bobbin will first be described for a better understanding of this invention. The conventional bobbin comprises a sleeve 21, a plurality of divider plates 23, and first and second end plates 25 and 27. The sleeve 21 has a sleeve internal surface 28 which defines a sleeve perforation. The divider plates 23 are attached to the sleeve with a space left between two adjacent ones of the divider plates 23 and with the divider plates 23 perpendicular to the sleeve 21. The first and the second end plates 25 and 27 are attached to side ends of the sleeve 21 with a space left between one of the divider plates 23 and each of the first and the second end plates 25 and 27.

Referring to Fig. 2, a conventional transformer will be described for a better understanding of this invention. Similar parts are designated by like reference numerals.

The conventional transformer comprises the bobbin, first and second coils 29 and 31 attached to the bobbin, a magnetic core (not shown) attached to the bobbin, and first-set and second-set connectors 33 and 35 fixed to the bobbin. The first and the second coils 29 and 31 are attached around the sleeve 21 between the divider plates 23. The first and the second coils 29 and 31 are connected to the first-set and the second-set connectors 33 and 35, respectively.

In the bobbin and the transformer, inasmuch as the divider plates 23 do not surround the first coil 29 or the second coil 31, it is hardly possible to reliably insulate the first coil 29 from the second coil 31 by the divider plates 23. Also, inasmuch as the divider plates 23 are perpendicular to the sleeve 21 and are high in height, the bobbin and the transformer are high in height.

Referring to Figs. 3 to 7, the description will proceed to a transformer of this invention.

The transformer comprises a bobbin 41, first and second coils 43 and 45 attached to the bobbin 41, first and second magnetic cores 47 and 49 attached to the bobbin 41, and first-set and second-set connectors 51 and 53 fixed to the bobbin 41.

The bobbin 41 is made of insulating material. The bobbin 41 comprises first and second boards 55 and 57, first and second sleeves 59 and 61, and a divider sleeve 63.

The first board 55 has a first board main surface 65, a first board subsidiary surface 67, and a first board internal surface 69 which defines a first board perforation. The second board 57 has a second board main surface 71 opposed to the first board main surface 65, a second board subsidiary surface 73, and second and third board internal surfaces 75 and 77 which define second and third board perforations.

The first sleeve 59 has a first sleeve internal surface 79 which defines a first sleeve perforation. The first sleeve 59 is integral with the first board 55 with the first sleeve perforation associated with the first board perforation. The second sleeve 61 has a second sleeve internal surface 81 which defines a second sleeve perforation. The second sleeve 61 is integral with the second board 57 with the second sleeve perforation associated with the second board perforation. The second board and the second sleeve perforations receive the first sleeve 59.

The divider sleeve 63 has a divider sleeve internal surface 83 which defines a divider sleeve perforation. The divider sleeve 63 is integral with the second board

57 with the divider sleeve 63 surrounding the second sleeve 61 and the third board perforation and with the divider sleeve 63 interposed between the first and the second board main surfaces 65 and 71 so that the divider sleeve 63 surrounds the first sleeve 59. The divider sleeve 63 is welded to the first board main surface 65. The divider sleeve 63 may be glued to the first board main surface 65.

The first coil 43 is attached around the divider sleeve 63 and is connected to the first-set connectors 51. The second coil 45 is attached around the second sleeve 61 and is connected to the second-set connectors 53 through the third board perforation.

The first magnetic core 47 has a first leg 85. The first magnetic core 47 is brought into contact with the first board subsidiary surface 67 with the first leg 85 inserted in the first sleeve perforation. The second magnetic core 49 has a second leg 87. The second magnetic core 49 is brought into contact with the second board subsidiary surface 73 with the second leg 87 inserted in the first sleeve perforation and brought into contact with the first leg 85. A first end portion of the first magnetic core 47 is brought into contact with a second end portion of the second magnetic core 49 and is glued to the second end portion.

Referring to Figs. 8 and 9, the description will proceed to a transformer for describing the background of this invention. The transformer comprises similar parts designated by like reference numerals.

The divider sleeve 63 is integral with the first board 55 with the divider sleeve 63 surrounding the first sleeve 59. The divider sleeve 63 further has a contact peak portion 89 which is brought into contact with the second board main surface 71. The divider sleeve 63 surrounds the second sleeve 61 and the third board perforation.

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The second board 57 has first side surfaces 91 to which the first-set connectors 53 are fixed. The third board internal surface 77 reaches the first side surfaces 91.

The second board 57 further has fourth and fifth board internal surfaces 93 and 95 which define fourth and fifth board perforations. First and second coupling arms 97 and 99 have first and second coupling peak portions and are integral with the first board 55. The first and the second coupling arms 97 and 99 pass through the fourth and the fifth board perforations with the first and the second peak portions brought into contact with the second board subsidiary surface 73.

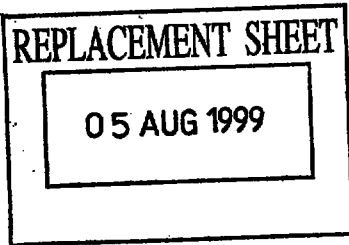
Referring to Figs. 10 and 11, the description will proceed to a transformer for describing the background of this invention. The transformer comprises similar parts designated by like reference numerals.

The second board 57 has first and second ditch surfaces 101 and 103 which reach from the second board main surface 71 to the second board subsidiary surface 73 and which define first and second ditches. The first and the second coupling arms 97 and 99 pass through the first and the second ditches with the first and the second coupling peak portions brought into contact with

the second board subsidiary surface 73. The second board 57 has a locating lug 105 which is inserted in the third board perforation.

While this invention has thus far been described in conjunction with Figs. 3 to 7, it will now be readily possible for those skilled in the art to put this invention into practice in various other manners. For example, in

Figs. 8 to 11, the divider sleeve 63 may be integral with the second board 57 with the divider sleeve 63 surrounding the second sleeve 61 and the third board perforation. In this event, the divider sleeve 63 is interposed

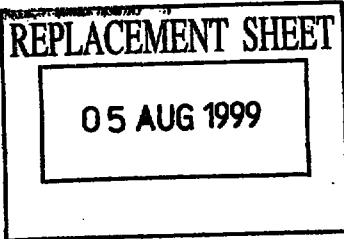


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between the first and the second board main surfaces 65 and 71 so that the divider sleeve 63 surrounds the first sleeve 59. The divider sleeve 63 has the contact peak portion 89 which is brought into contact with the first board main surface 65.

Also, the divider sleeve 63 may have not the contact peak portion 89. In this event, the divider sleeve 63 is directly brought into contact with the first or the second board main surface 65 or 71.

**WHAT IS CLAIMED IS :**

1. A transformer comprising a bobbin, first and second coils (43, 45) attached to said bobbin, first and second magnetic cores (47, 49) attached to said bobbin, and first and second connectors (51, 53) fixed to said bobbin, wherein:

said bobbin comprises:

a first board (55) having a first board main surface (65) and a first board internal surface (69) which defines a first board perforation;

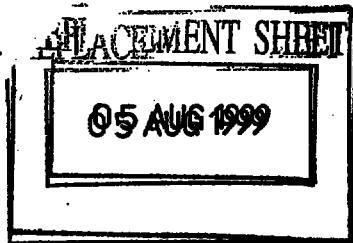
a second board (57) having a second board main surface (71) opposed to said first board main surface (65) and second board internal surface (75) which defines a second board perforation;

a first sleeve (59) having a first sleeve internal surface (79) which defines a first sleeve perforation, said first sleeve (59) being integral with said first board (55) with said first sleeve perforation associated with said first board perforation;

a second sleeve (61) having a second sleeve internal surface (81) which defines a second sleeve perforation, said second sleeve (61) being integral with said second board (57) with said second sleeve perforation associated with said second board perforation;

a divider sleeve (63) for receiving said first coil (43) and having a divider sleeve internal surface (83) which defines a divider sleeve perforation;





said first coil (43) being connected to said first connectors (51);
said divider sleeve (63) being interposed between said first and
said second board main surfaces (65, 71) so that said divider sleeve (63) surrounds said first sleeve (59);

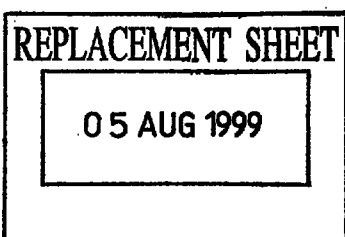
characterized in that

said second board (57) comprises a third board internal surface (77) which defines a third board perforation,
said divider sleeve (63) is integral with said second board (57) with said divider sleeve (63) surrounding said third board perforation,
said second board (57) and said second sleeve perforations receive said first sleeve (59),
said second sleeve (61) is provided for receiving said second coil (45),
said second coil (45) being connected to said second connectors (53) through said third board perforation,
said divider sleeve (63) is welded or glued to said first board main surface (65).

2. A transformer comprising a bobbin, first and second coils (43, 45) attached to said bobbin, first and second magnetic cores (47, 49) attached to said bobbin, and first and second connectors (51, 53) fixed to said bobbin, wherein:

said bobbin comprises:





a first board (55) having a first board main surface (65) and a first board internal surface (69) which defines a first board perforation;

a second board (57) having a second board main surface (71) opposed to said first board main surface (65) and second board internal surface (75) which defines a second board perforation;

a first sleeve (59) having a first sleeve internal surface (79) which defines a first sleeve perforation, said first sleeve (59) being integral with said first board (55) with said first sleeve perforation associated with said first board perforation;

a second sleeve (61) having a second sleeve internal surface (81) which defines a second sleeve perforation, said second sleeve (61) being integral with said second board (57) with said second sleeve perforation associated with said second board perforation;

a divider sleeve (63) for receiving said first coil (43) and having a divider sleeve internal surface (83) which defines a divider sleeve perforation;

said first coil (43) being connected to said first connectors (51)

said divider sleeve (63) being interposed between said first and

said second board main surfaces (65, 71) so that said divider sleeve (63) surrounds said first sleeve (59);

characterized in that



said second board (57) comprises a second board subsidiary surface (73), and third, fourth, and fifth board internal surfaces (75, 93, 95) which define third, fourth, and fifth board perforations,

said divider sleeve (63) is integral with said second board (57) with said divider sleeve (63) surrounding said third board perforation and said divider sleeve (63) being brought into contact with said first board main surface (65),

said second board (57) and said second sleeve perforations receive said first sleeve (59),

said second sleeve (61) is provided for receiving a second coil (45),

said second coil being connected to said second connectors (53) through said third board perforation,

first and second coupling arms (97, 99) have first and second coupling peak portions, said first and said second coupling arms (97, 99) are integral with said first board (55), said first and said second coupling arms (97, 99) pass through said fourth and

said fifth board perforations with said first and said second coupling peak portions brought into contact with said second board subsidiary surface (73).

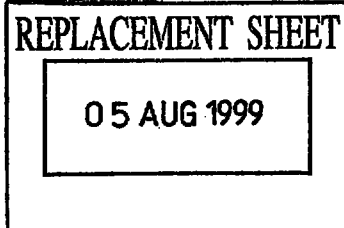
3. A transformer comprising a bobbin, first and second coils (43, 45) attached to said bobbin, first and second magnetic cores (47, 49) attached to said bobbin, and first and second connectors (51, 53) fixed to said bobbin, wherein:

said bobbin comprises:

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a first board (55) having a first board main surface (65) and a first board internal surface (69) which defines a first board perforation;

a second board (57) having a second board main surface (71) opposed to said first board main surface (65) and second board internal surface (75) which defines a second board perforation;

a first sleeve (59) having a first sleeve internal surface (79) which defines a first sleeve perforation, said first sleeve (59) being integral with said first board (55) with said first sleeve perforation associated with said first board perforation;

a second sleeve (61) having a second sleeve internal surface (81) which defines a second sleeve perforation, said second sleeve (61) being integral with said second board (57) with said second sleeve perforation associated with said second board perforation;

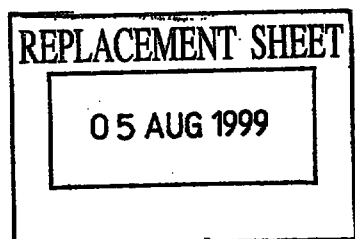
a divider sleeve (63) for receiving said first coil (43) and having a divider sleeve internal surface (83) which defines a divider sleeve perforation;

said first coil (43) being connected to said first connectors (51);

said divider sleeve (63) interposed between said first and said second board main surfaces (65, 71) so that said divider sleeve (63) surrounds said first sleeve (59);



characterized in that



said second board (57) comprises a second board subsidiary surface (73), a third board internal surface (77) which defines a third board perforation and first and second ditch surfaces (101, 103) which reach from said second board main surface (71) to said second board subsidiary surface (73) and define first and second ditches;

said divider sleeve (63) is integral with said second board (57) with said divider sleeve (63) surrounding said third board perforation and said divider sleeve (63) is brought into contact with said first board main surface (65),

said second board (57) and said second sleeve perforations receive said first sleeve (59),

said second sleeve (61) is provided for receiving a second coil (45),

said second coil (45) being connected to said second connectors (53) through said third board perforation,

first and second coupling arms (97, 99) have first and second coupling peak portions, said first and said second coupling arms (97, 99) are integral with said first board (55), said first and said second coupling arms (97, 99) pass through said first and

said second ditches with said first and said second coupling peak portions brought into contact with said second board subsidiary surface (73).

4. A transformer as claimed in claim 2 or 3, said divider



sleeve (63) further having a contact peak portion (89) which is brought into contact with said first board main surface (65).

5. A transformer as claimed in one of claims 2 to 4, said first magnetic core (47) having a first leg (85), said first magnetic core (47) being brought into contact with a first board subsidiary surface (67) of said first board (55) with said first leg (85) inserted in said first sleeve perforation, said second magnetic core (49) having a second leg (87), said second magnetic core (49) being brought into contact with said second board subsidiary surface (73) with said second leg (87) inserted in said first sleeve perforation and brought into contact with said first leg (85).
6. A transformer as claimed in claim 1, said first magnetic core (47) having a first leg (85), said first magnetic core (47) being brought into contact with a first board subsidiary surface (67) of said first board (55) with said first leg (85) inserted in said first sleeve perforation, said second magnetic core (49) having a second leg (87), said second magnetic core (49) being brought into contact with a second board subsidiary surface (73) of said second board (57) with said second leg (87) inserted in said first sleeve perforation and brought into contact with said first leg (85).
7. A transformer as claimed in one of claims 1 to 6, wherein said first and second connectors (51, 53) are fixed to said second board (57).

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